isrjournals

International Journal of Advanced Research in Civil,Structural,Environmental and Infrastructure Engineering and Developing

Volume: 3 Issue: 1 Feb,2017,ISSN_NO: 2320-723X

SOIL STABILIZATION BY ELECTRO KINETIC TECHNIQUE

V.Samidurai,K.Jeevanandan,R.Ragul

Department of Civil Engineering, Panimalar Engineering College, Chennai, India.

ABSTRACT : *Stabilization of soil using Electro kinetic technique is a technique which uses Direct Current to a series of Electrodes which are immersed in the soil. This Treatment is an effective treatment for the soil improvement technique to increase the shear strength of the soil, among the various stabilization techniques. This stabilization is done to improve the engineering properties of the subsoil surface while having minimum disturbance to the surface. This study aims to investigate the effects of EK treatment at different voltages and at different intervals. The objective of this work is to influence the pattern arrangement of electrodes on the shear strength of the soil. The various comparisons the tests are pattern of electrodes, DC voltage &spacing. The shear strength of the soil samples are found out by conducting unconfined compression tests before and after the electro kinetic stabilization of the soil. The water content of the soils was also checked before and after the test. The comparison between the pattern, voltage resistance & spacing were also Studied. The test reports indicate that the compressive and the shear strength of the soil has considerably improved after the electro kinetic stabilization treatment of the soil.*

Key words: Soft clay soil, Electrodes, Spacing, Voltage, Pattern,Electrokinetic.

1.INTRODUCTION

Soft clay soil is a very fine grained natural rock it is also a soil material which contains one or more clay minerals. They are plastic in nature because of their water content during the wet Season and even they are hard, brittle during the dry season. Clay soils appear in various colours like white to dull gray and they even appear in brown to deep orange red. They are even differentiated from many other fine grained soils by variation in size and mineralogy. The plasticity and liquidity properties are found out for this soft clay soil using Atterbergs Limits. These soils are very rich in iron, magnesium, alkali metals, and alkaline earths. They also expand and contact according to wet and dry season respectively hence they are not stable soils. To stabilize these soils there are many ground improvement techniques and stabilization techniques. Some of the stabilizations are wet stabilization, dry stabilization, and stabilization with cement, stabilization with lime, stabilization with bitumen, mechanical stabilization, thermal stabilization, and electrical stabilization. Electro kinetic stabilization is a soil improvement technique by supplying electric current from a DC circuit to a series of electrodes which are present in the soil. Electro-osmosis system is approved stabilization technique on fine grained soils. When the electric current is applied to mass of soil the pore fluid moves from anode region to cathode region where the positive ions move towards the region of negative electrode and the positive electrode is noticed with reduced water content and improves the strength at the region of anode. The electrodes are made up of copper because copper and its alloys form the best material for the electrode for the electro-osmosis process and that a uniform increase of resistance in soil during the process increases the

efficiency of the process. The electric currentapplied to the electrodes leads to an electrolysis reactions in the electrodes.

2. MATERIALS

Soil samples were collected from SIPCOT, Chennai for the present study. The liquid and plastic limit of the soil is 54.086% and 28.61% respectively. The soil is classified as „CH" type. The lime was purchased for about 10kg in readymade. The physical properties of soil is shown below.

3.ELECTRO KINETIC SETUP

In order to study the electrokinetic phenomena in soils, an electrokinetic cell was designed and fabricated which has the components like rectangular box open at top, electrodes, voltmeter, ammeter, AC to DC transformer and multimeter. Figure shows the schematic diagram of the fabricated cell. The dimensions of the box are 500 x 300 x 300 mm. The soil sample of varying initial moisture content will be placed in the tube up to a height of 10cm by hand remoulding. At the cathode end, provision is given at the bottom of box to collect the drained water during the process of passage of current across the soil sample. The voltmeter is provided to measure the voltage applied. The voltage can be varied as 50 V and 60 V. The ammeter is used to measure the amount of current passing through the soil sample. The ammeter is capable of measuring current from 1 A to 10 A. The cathodic electrode is made up of copper with perforations to facilitate removal of water and the anodic electrode is made up of zinc. The transformer converts the incoming AC current to DC current. The transformer, voltmeter and ammeter are fitted together in a small box so that the apparatus is compact

3.1 SOIL PROPERTIES

Soil – The soil samples to be tested are collected from the area of , Thiruvallur. The collected samples were air dried at room temperature and the soil lumps present are powdered in the sample and it is sieved through a 425micron sieve before the same soil is used for laboratory tests. The soil consists of 42%clay & 33%silt by testing the soil sample the liquid limit and plastic limit were 75% and 30% respectively and it is classified as CH type of soil.

SI NO	Properties	Value
1	Colour of soil	Brown
2	Presence of clay	42%
3	Presence of silt	33%
4	Liquid limit (Initial)	75%
5	Plastic limit (Initial)	30%
6	Unconfined compression test (Initial)	72KPa
7	Liquid limit (Final)	64%
8	Plastic limit (Final)	23%

4.EXPERIMENTAL PROCEDURE

- The amount of soil needed is calculated using the volume of the tank. The marine soil was mixed with 30% water content (OMC) in order to achieve a dry density of 13.6kN/m3.
- The soil sample was initially filled in the glass tank. Before starting the test UCC test was conducted on the soil sample and it was 72KPa. The water content of the soil sample was also tested.
- The electrodes were arranged in a series as shown in the figure. By applying

Volume: 3 Issue: 1 Feb,2017,ISSN_NO: 2320-723X

the specified DC volt for a specified time of 2hrs the water was simultaneously collected at cathode by passing the current for the specified period of time.

And the collected amount of water was noted for different intervals (10cm-15cm), varied voltage (50V-60V). After conducting the tests the soil sample is tested for its water content & Unconfined compression test.

- The electrodes should be arranged in correct and regular pattern if the pattern is irregular then test will not be efficient.
- Initially the test is done for 50V, 10cm in this the DC circuit transfers 50V of DC current to the soil through the electrodes for a specified time the measuring

jar collects the water and the corresponding time is noted down.
- In the next test the volts are same and the spacing is increased to 15cm for a specified time is noted down for the amount of water collected in the measuring jar.
- The tests are repeated for both 60V, 10cm & 60V, 15cm and the corresponding amount of water collected is noted down respectively. These readings are plotted in the graph.
- While passing the current in the soil after the increase in time the Intensity of the current decreases automatically which is observed in the Ammeter due to the lack of presence of moisture content in the soil. The Intensity of the current is also checked for (50V, 10cm & 15cm) & (60V,10cm & 15cm).

5.RESULTS AND CONCLUSION

1. Comparison is made with the volume of water collected at the cathode for the current pattern and various intervals and voltages.

2. When the voltage is increased the water collected at the cathode is also Increased. The below graphs show that the amount of volume of water collected also increases with increase in spacing

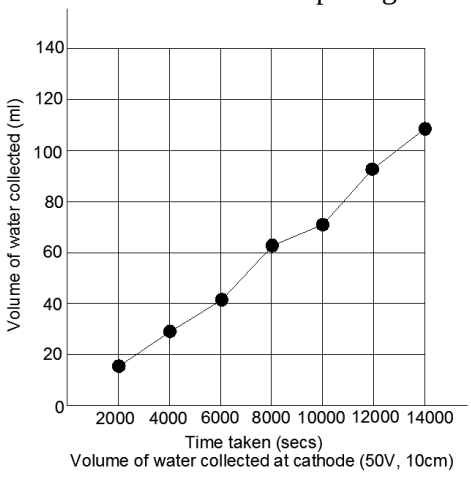

FIGURE – 1

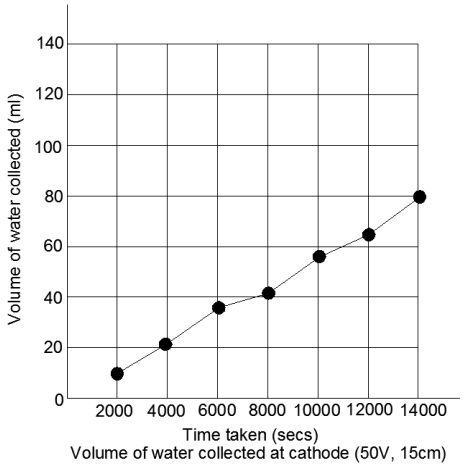

FIGURE – 2

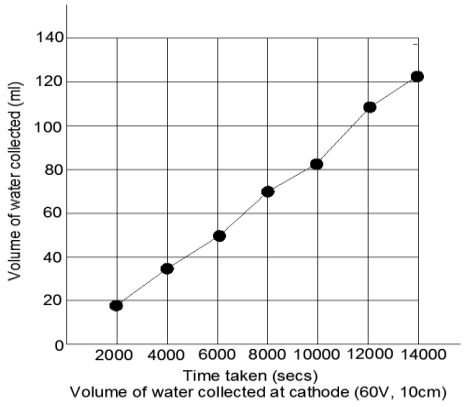

FIGURE – 3

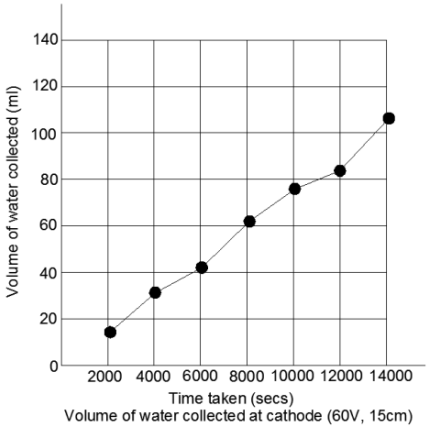

FIGURE – 4

The Above graphs show that the amount of volume of water collected also increases with increase in volts and also with increase in spacing

we conclude following from the experiment

1. With the application of DC current through the sample undergoes anelectromigration process that take place within the soil porous media.
2. The observation made was the development of wet and drier areas between the electrodes due to the positive electroosmotic flow from anode to cathode.
3. Higher rate of electro osmotic flow is observed during the early stage of electrokinetic process while with processing time.
4. A gradual decrease in rate of electro osmotic flow was noted at the end of the processing time.

REFERENCES

1. Afshin, A., Bujang, B. K., Hassim, M.M., Thamer, A.M.,Hanafi, M. M., and Nader, S. (2009).“Electroosmotic Phenomena in Organic Soils”, American Journal of Environmental Sciences, Vol. 5, No. 3, pp. 310-314.
2. Daniel, T., and Paravita, S.W. (2007). “Improving marine clays with electrokinetics method”, Civil Engineering Dimension, Vol. 9, No. 1,pp. 98-102.
3. Kamarudin, A., Khairul, A. K., and Taha, M. R. (2006). “Electroosmotic Flows and Electromigrations During Electrokinetic Processing of Tropical Residual Soil” Malaysian Journal of Civil Engineering,Vol. 8,No.2,pp. 74-88.
4. Kamarudin, B. A., Raihan Taha, M., and Khairul, A. K. (2011). “Electrokinetic Treatment on a Tropical Residual Soil”.
5. Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain “Soil Mechanics and Foundations” on Liquid, Plastic Limit and Unconfined Compression Test.
6. Kurochkina.G.N. Pinskii.D.L, Haynos.M, Sokolowska.Z, Tesla.I (2014). “Electrokinetic properties of soil minerals and soils modified with polyelectrolytes” Physics abstract service.
7. Mena Ramirez.E, Villasenor Camacho J, Rodrigo Rodrigo.M.A, Canizares.P (2014) “Feasibility of electrokinetic oxygen supply for soil bioremediation purposes” NCBI.
8. “Transfer of Radioactive ions in soils be electrokinetics” Office of Scientific and Technical Information(OSTI).